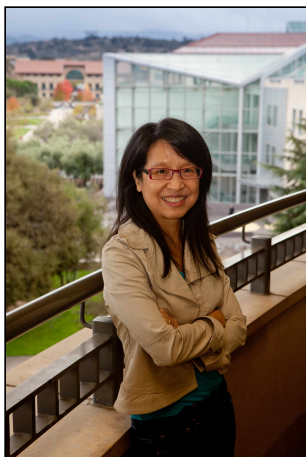# EXHIBIT Y

Monica S. Lam 林倩玲

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Biography

Monica Lam is a Professor in the Computer Science Department at Stanford University since 1988. She is the faculty director of the Open Virtual Assistant Lab (OVAL). She received a B.Sc. from University of British Columbia in 1980 and a Ph.D. in Computer Science from Carnegie Mellon University in 1987. Monica is a Member of the National Academy of Engineering and an ACM Fellow. She is a co-author of the popular text Compilers, Principles, Techniques, and Tools (2nd Edition), also known as the Dragon book.

Professor Lam's current research is on conversational virtual assistants with an emphasis on privacy protection. Her research uses deep learning to map task-oriented natural language dialogues into formal semantics, represented by a new executable programming language called ThingTalk. Her Almond virtual assistant, trained on open knowledge graphs and IoT API standards, can be easily customized to perform new tasks. She is leading an Open Virtual Assistant Initiative to create the largest, open, crowdsourced language semantics model to promote open access in all languages. Her decentralized Almond virtual assistant that supports fine-grain sharing with privacy has received Popular Science's Best of What's New Award in Security in 2019.

Prof. Lam is also an expert in compilers for high-performance machines. Her pioneering work of affine partitioning provides a unifying theory to the field of loop transformations for parallelism and locality. Her software pipelining algorithm is used in commercial systems for instruction level parallelism. Her research team created the first, widely adopted research compiler, SUIF. Her contributions in computer architecture include the CMU Warp Systolic Array and the Stanford DASH Distributed Memory Multiprocessor. She was on the founding team of Tensilica, now a part of Cadence.

She received an NSF Young Investigator award in 1992, the ACM Most Influential Programming Language Design and Implementation Paper Award in 2001, an ACM SIGSOFT Distinguished Paper Award in 2002, the ACM Programming Language Design and Implementation Best Paper Award in 2004, the ACM SIGARCH/SIGPLAN/SIGOPS ASPLOS Influential Paper Awards in two consecutive years, 2021 and 2022. She was the author of two of the papers in "20 Years of PLDI--a Selection (1979-1999)", and one paper in the "25 Years of the International Symposia on Computer Architecture". She received the University of British Columbia Computer Science 50th Anniversary Research Award in 2018.

Recent Presentations and Interviews

[Importance of voice technology to the humanitarian community](#)
Interviewed by Mark Dalton in Humanitarian AI Today, July 2021

Genie: An Open Privacy Preserving Virtual Assistant
Keynote at the 48th International Symposium on Computer Architecture, June 2021.

Stanford Almond Open Source Voice Assistant – Voicebot Podcast Ep 175
Interviewed by Bret Kinsella for Voicebot.AI, October 2020.

"Stanford Team Aims at Alexa and Siri With a Privacy-Minded Alternative"
Written by John Markoff for the New York Times, June 2019

"Privacy in the Age of Virtual Assistants" Video,
The Future of Everything Podcast, Stanford School of Engineering,
Stanford, June 4, 2019.
(Top 5 of 100 Videos Award).

"Giving Control Back to Consumers with Open Federated Virtual Assistants" Video,
Keynote at the High Performance and Embedded Architecture and Compilation (HiPEAC) Conference,
Valencia, Spain, January 2019.

Almond: Keeping the Internet Open with An Open-Source Virtual Assistant (Video, Slides)
Keynote at the 24th Annual International Conference on Mobile Computing and Networking (Mobicom),
New Dehli, India, November, 2018.

Research Interests

Virtual Assistant. Machine learning. Natural language programming. Distributed mobile computing.

Current Research

The Open Virtual Assistant Lab

Previous Research Projects

Mobile and social computing, a part of the Programmable Open Mobile Internet (POMI) 2020 project.
Improving Program Robustness via Static Analysis and Dynamic Instrumentation.
The Collective: an Appliance-Based Computing Architecture.
The SUIF Compiler System

Current PhD Students

Mehrad Moradshahi
Sina Semnani
Silei Xu
Jackie Yang

Ph.D. Graduates

Michael Wolf	Shih-wei Liao, National Taiwan University	John Whaley, UnifyID
Michael Smith, Harvard	Brian Schmidt, Google	Michael Martin, Roblox
Todd Mowry, CMU	Patrick Sathyanathan	Christopher Unkel, DriveScale
Martin Rinard, MIT	Amy Lim, Cadence	

Daniel Scales, Google
Saman Amarasinghe, MIT
Jennifer Anderson, Uber
Robert Wilson, Apple
Jason Nieh, Columbia
University

Brian Murphy, Amazon
Jeffrey Oplinger, Oracle
David Heine, Google
Constantine Sapuntzakis, Pure Storage
V. Benjamin Livshits, Imperial College
London

Sudheendra Hangal, Ashoka
University
Jiwon Seo, Hanyang University
Michael Fischer
Giovanni Campagna

Recent Papers

1. *A Few-Shot Semantic Parser for Wizard-of-Oz Dialogues with the Precise ThingTalk Representation*
   Giovanni Campagna, Sina J. Semnani, Ryan Kearns, Lucas Jun Koba Sato, Monica S. Lam
   In *Findings of the Association for Computational Linguistics (ACL)*, Dublin, Ireland, July 2022.
2. *HybridTrak: Adding Full-Body Tracking to VR Using and Off-the-Shelf Webcam*
   Jackie (Junrui) Yang, Tuochao Chen, Fang Qin, Monica S. Lam, James A. Landay
   In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, New Orleans, LA,
   April 2022.
3. *DIY Assistant: A Multi-Modal End-User Programmable Virtual Assistant*
   Michael H. Fischer, Giovanni Campagna, Euirim Choi, Monica S. Lam
   In *Proceedings of the 42nd ACM SIGPLAN International Conference on Programming Language Design
   and Implementation (PLDI 2021)*, June 2021.
4. *Grounding Open-Domain Instructions to Automate Web Support Tasks*
   Nancy Xu, Sam Masling, Michael Du, Giovanni Campagna, Larry Heck, James Landay, Monica S Lam
   In *Proceedings of the 2021 Annual Conference of the North American Chapter of the Association for
   Computational Linguistics (NAACL-HLT 2021)*, June 2021.
5. *AutoQA: From Databases To Q&A Semantic Parsers With Only Synthetic Training Data*
   Silei Xu, Sina J. Semnani, Giovanni Campagna, Monica S. Lam
   In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing*,
   November 2020.
6. *Localizing Open-Ontology QA Semantic Parsers in a Day Using Machine Translation*
   Mehrad Moradshahi, Giovanni Campagna, Sina J. Semnani, Silei Xu, Monica S. Lam
   In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing*,
   November 2020.
7. *DoThisHere: Multimodal Interaction to Improve Cross-Application Tasks on Mobile Devices*
   Jackie Yang, Monica S. Lam, James A. Landay
   In *Proceedings of the 33rd Annual ACM Symposium on User Interface Software and Technology (UIST)*,
   October 2020.
8. Schema2QA: High-Quality and Low-Cost Q&A Agents for the Structured Web
   Silei Xu, Giovanni Campagna, Jian Li, and Monica S. Lam
   In *Proceedings of the 29th ACM International Conference on Information and Knowledge Management*,
   October 2020.
9. Zero-Shot Transfer Learning with Synthesized Data for Multi-Domain Dialogue State Tracking
   Giovanni Campagna, Agata Foryciarz, Mehrad Moradshahi, and Monica S. Lam
   In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics* (Volume 1:
   Long Papers), July 2020.
10. Soundr: Head Position and Orientation Using a Microphone Array
    Jackie (Junrui) Yang, Gaurab Banerjee, Vishesh Gupta, Monica S. Lam, James A. Landay
    In *Proceedings of the CHI Conference on Human Factors in Computing Systems*,
    Honolulu, HI, April 2020.
11. ImagineNet: Restyling Apps Using Neural Style Transfer
    Michael H. Fischer, Richard R. Yang, Monica S. Lam
    arXiv preprint arXiv:2001.04932, January 2020.

12. [Protecting privacy and open competition with almond: an open-source virtual assistant](#)
    Monica S. Lam, Giovanni Campagna, Silei Xu, Michael Fischer, Mehrad Moradshahi
    XRDS: Crossroads, The ACM Magazine for Students, Vol. 26, Issue 1, September 2019

13. [Genie: A Generator of Natural Language Semantic Parsers for Virtual Assistant Commands](#)
    Giovanni Campagna, Silei Xu, Mehrad Moradshahi, Richard Socher, and Monica S. Lam
    In *Proceedings of the 40th ACM SIGPLAN Conference on Programming Language Design and Implementation,*
    Pheonix, AZ, June 2019.

14. [Controlling Fine-Grain Sharing in Natural Language with a Virtual Assistant](#)
    Giovanni Campagna, Silei Xu, Rakesh Ramesh, Michael Fischer, and Monica S. Lam
    In *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT),*
    Singapore, October 2018.

15. [Brassau: Automatically Generating Graphical User Interfaces for Virtual Assistants](#)
    Michael Fischer, Giovanni Campagna, Silei Xu, and Monica S. Lam
    In *20th International Conference on Human-Computer Interaction with Mobile Devices and Services. (MobileHCI),*
    Barcelona, Spain, September 2018.

16. [Almond: The Architecture of an Open, Crowdsourced, Privacy-Preserving, Programmable Virtual Assistant](#)
    Giovanni Campagna, Rakesh Ramesh, Silei Xu, Michael Fischer, and Monica S. Lam.
    In *Proceedings of the 26th World Wide Web Conference,*
    Perth, Australia, April 2017.

Selected Publications

Distributed social networks

1. [Musubi: Disintermediated Interactive Social Feeds for Mobile Devices](#)
   Ben Dodson, Ian Vo, T. J. Purtell, Aemon Cannon, and Monica S. Lam
   In *Proceedings of the 21st International WWW Conference (WWW2012)*
   Lyon, France, April 2012. (Finalist of Best Student Paper).
2. [Email Clients as Decentralized Social Apps in Mr. Privacy](#)
   Michael Fischer, T. J. Purtell, and Monica S. Lam
   In *Proceedings of the 4th Hot Topics in Privacy Enhancing Technologies (HotPETs 2011)*
   Waterloo ON, Canada, July 2011.

Distributed graph-based databases

3. [SociaLite: An Efficient Graph Query Language Based on Datalog](#)
   Jiwon Seo, Stephen Guo, and Monica S. Lam
   In *IEEE Transactions on Knowledge and Data Engineering,* 99, February 2015.
4. [Distributed SociaLite: A Datalog-Based Language for Large-Scale Graph Analysis](#)
   Jiwon Seo, Jongsoo Park, Jaeho Shin, and Monica S. Lam
   In *Proceedings of 40th International Conference on Very Large Data Bases (VLDB),* Hangzhou, China, August 2013.

Personalized Digital Experience

5. [Historical Research Using Email Archives](#)
   Sudheendra Hangal, Vihari Piratla, Chaiyasit Manovit, Peter Chan, Glynn Edwards, Monica S. Lam
   In *CHI-2015 Case Studies: ACM Computer Human Interaction*
   Seoul, Korea, April 2015.
6. [Effect Of Phonemic Cuing On Recall Of Personally Relevant Names Derived From Email](#)
   Allyson C. Rosen, Ankit Mathur, Monica S. Lam, Sudheendra Hangal

Poster at the *2015 International Neuropsychological Society Annual Meeting*
Denver, CO, February 2015.

7. [Personalized Memory Testing for Names Using Email Archives](#)
Sudheendra Hangal, Allyson C. Rosen, Ankit Mathur, Monica S. Lam
In *BrainKDD: International Workhop on Data Mining for Brain Science*, in conjunction with ACM
SIGKDD'14, New York City, August 2014.

8. [Effective Browsing and Serendipitous Discovery with an Experience-Infused Browser](#)
Sudheendra Hangal, Abhinay Nagpal, and Monica S. Lam
In *Proceedings of the 2012 International Conference on Intelligent User Interfaces (IUI)*
Lisbon, Portugal, February 2012.

9. [Friends, Romans, Countrymen: Lend me your URLs. Using Social Chatter to Personalize Web Search.](#)
Abhinay Nagpal, Sudheendra Hangal, Rifat Reza Joyee, and Monica S. Lam
In *Proceedings of the ACM Conference on Computer Supported Cooperative Work (CSCW)*
Seattle WA, February 2012.

10. [MUSE: Reviving Memories Using Email Archives](#)
Sudheendra Hangal, Monica S. Lam, and Jeffrey Heer
In *Proceedings of the 24th ACM Symposium on User Interface Software and Technology (UIST)*
Santa Barbara CA, October 2011.

11. [An Algorithm and Analysis of Social Topologies from Email and Photo Tags](#)
T. J. Purtell, Diana MacLean, Seng Keat Teh, Sudheendra Hangal, Monica S. Lam, and Jeffrey Heer
In *Proceedings of the Fifth ACM Workshop on Social Network Mining and Analysis*
Held in conjunction with the ACM SIGKDD International Conference on Knowledge Discovery and Data
Mining (KDD)
San Diego, CA, August 2011.

12. [Groups Without Tears: Mining Social Topologies from Email](#)
Diana MacLean, Sudheendra Hangal, Seng Keat Teh, Monica S. Lam, and Jeffrey Heer
In *Proceedings of the 2011 International Conference on Intelligent User Interfaces (IUI)*, Palo Alto, CA,
February 2011.

Computer System Manageability

13. [The Collective: A Cache-Based System Management Architecture](#)
R. Chandra, N. Zeldovich, C. P. Sapuntzakis and M. S. Lam
In Proceedings of the Second Symposium on Networked Systems Design and Implementation, May 2005.

14. [The Interactive Performance of SLIM: A Stateless, Thin-Client Architecture](#)
B. K. Schmidt, M. S. Lam, and J. D. Northcutt
In Proceedings of the Seventeenth ACM Symposium on Operating Systems Principles, December 1999.
Published as *Operating Systems Review*, 34(5):32-47.

Program Analysis for Reliability and Security

15. [Automatic Generation of XSS and SQL Injection Attacks with Goal-Directed Model Checking.](#)
Martin, Michael C., Lam, M. S.

In *Proceedings of the 17th USENIX Security Symposium*, (San Jose, CA, 30 July-1 August, 2008), pages
31-43.

16. [Securing Web Applications Using Static and Dynamic Information Flow Tracking,](#)
M. S. Lam, M.C. Martin, V. B. Livshits, and J. Whaley,
In *ACM Sigplan 2008 Workshop on Partial Evaluation and Program Manipulation*, (Keynote address),
January 2008.

17. [Finding Application Errors and Security Flaws Using PQL: a Program Query Language.](#)
Michael Martin, V. Benjamin Livshits, and Monica S. Lam
In *Proceedings of the Conference on Object-Oriented Programming, Systems, Languages and
Applications (OOPSLA '05)*, October 2005.

18. [Finding Security Vulnerabilities in Java Applications Using Static Analysis](#)
    V. Benjamin Livshits and Monica S. Lam
    In *Proceedings of the 14th USENIX Security Symposium*, August 2005.
19. [Static Detection of Leaks in Polymorphic Containers.](#)
    David Heine and Monica S. Lam
    In *Proceeding of the 28th International Conference on Software Engineering*, (Shanghai, China, 20-28 May, 2006), pages 252-261.
20. [Context-Sensitive Program Analysis as Database Queries](#)
    Monica S. Lam, John Whaley, V. Benjamin Livshits, Michael C. Martin, Dzintars Avots, Michael Carbin and Christopher Unkel.
    In Proceedings of the 24th SIGMOD-SIGACT-SIGART Symposium on Principles of Database Systems, June, 2005. (Invited Tutorial).
21. [Cloning-Based Context-Sensitive Pointer Alias Analysis Using Binary Decision Diagrams](#)
    John Whaley and Monica S. Lam
    In Proceedings of the ACM SIGPLAN 2004 Conference on Programming Language Design and Implementation, June 2004.
    ACM Programming Language Design and Implementation Best Paper Award, 2004.
22. [A Practical Flow-Sensitive and Context-Sensitive C and C++ Memory Leak Detector](#)
    D. L. Heine and M. S. Lam
    In Proceedings of the ACM SIGPLAN 2003 Conference on Programming Language Design and Implementation, June 2003.
23. [Tracking Down Software Bugs Using Automatic Anomaly Detection](#)
    S. Hangal and M. S. Lam
    In Proceedings of the 24th International Conference on Software Engineering, May 2002.([gzip'ed postscript](#)).

Parallelization and Locality Optimization

24. [Interprocedural Parallelization Analysis in SUIF](#),
    M. W. Hall, S. P. Amarasinghe, B. R. Murphy, S.-W. Liao, and M. S. Lam,
    ACM Transactions on Programming Languages and Systems, July 2005, *27*(4), pp. 662-731.
25. [Blocking and Array Contraction Across Arbitrarily Nested Loops Using Affine Partitioning](#)
    A. W. Lim, S.-W. Liao and M. S. Lam
    In Proceedings of the ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming, June 2001.
26. [An Affine Partitioning Algorithm to Maximize Parallelism and Minimize Communication](#)
    A. W. Lim, G. I. Cheong and M. S. Lam
    In Proceedings of the 13th ACM SIGARCH International Conference on Supercomputing, June, 1999, pp. 228-237.
27. [Maximizing Parallelism and Minimizing Synchronization with Affine Partitions](#)
    A. W. Lim and M. S. Lam
    Parallel Computing, Vol. 24, Issue 3-4, May 1998, Pages 445-475. ([PDF](#))
    (A preliminary version appeared as Maximizing Parallelism and Minimizing Synchronization with Affine Transform, in the Conference Record of the 24th Annual ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages, January, 1997.)
28. [Maximizing Multiprocessor Performance with the SUIF Compiler](#)
    M. W. Hall, J. M. Anderson, S. P. Amarasinghe, B. R. Murphy, S.-W. Liao, E. Bugnion and M. S. Lam
    IEEE Computer, December 1996.
    (A special issue on multiprocessors).
29. [Detecting Coarse-Grain Parallelism Using an Interprocedural Parallelizing Compiler](#) ([PostScript](#))
    M. W. Hall, S. P. Amarasinghe, B. R. Murphy, S. Liao, and M. S. Lam,
    In Proceedings of Supercomputing '95, December 1995.
30. [Global Optimizations for Parallelism and Locality on Scalable Parallel Machines](#) ([PostScript](#))
    J. M. Anderson and M. S. Lam

Monica Lam

In Proceedings of the ACM SIGPLAN'93 Conference on Programming Language Design and Implementation, June, 1993.
31. [Design and Evaluation of a Compiler Algorithm for Prefetching](PDF)
T. C. Mowry, M. S. Lam and A. Gupta
In Proceedings of the Fifth International Conference on Architectural Support for Programming Languages and Operating Systems, October, 1992.
32. [A Data Locality Optimizing Algorithm]
M. E. Wolf and M. S. Lam
In Proceedings of the ACM SIGPLAN'91 Conference on Programming Language Design and Implementation, June 1991.
ACM Most Influential PLDI Paper Award, 2001.
Included in 20 Years of PLDI (1979-1999): A Selection, 2004. ([A retrospective]).
33. [Software Pipelining: An Effective Scheduling Technique for VLIW Machines.]
M. Lam.
In Proceedings of the SIGPLAN 88 Conference on Programming Language Design and Implementation, June 1988, pp. 318-328.
Included in 20 Years of PLDI (1979-1999): A Selection, 2004. ([A retrospective]).

Architecture

34. [Limits of Control Flow on Parallelism] ([PostScript])
M. S. Lam and R. P. Wilson
In Proceedings of the 19th Annual International Symposium on Computer Architecture, May, 1992.
35. The Stanford DASH Multiprocessor
D. Lenoski, J. Laudon, K. Gharachorloo, W.-D. Weber, A. Gupta, J. L. Hennessy, M. Horowitz, and M. S. Lam.
IEEE Computer. 25, (3): 63-79, March, 1992.
36. [The Cache Performance and Optimizations of Blocked Algorithms]
M. S. Lam, E. E. Rothberg and M. E. Wolf
In Proceedings of the Fourth International Conference on Architectural Support for Programming Languages and Operating Systems, April 1991.
37. The Warp Computer: Architecture, Implementation and Performance.
M. Annaratone, E. Arnould, T. Gross, H. T. Kung, M. Lam, and O. Menzilcioglu
IEEE Transactions on Computers, December 1987, C-36, 12, pp. 1523-1538.
(A preliminary version appeared as Warp Architecture and Implementation, which appeared in the

Proceedings of the 13th Annual Symposium on Computer Architecture, (Tokyo, Japan, 2-5 June 1986). pp. 346-356.
Included in 25 Years of the International Symposia on Computer Architecture, 2008.)

- [The Almond open-source and user-programmable virtual assistant project]
- [MobiSocial Computing Group Home Page]
- [The SUIF Research Group Home Page]
- [The Collective Research Group Home Page]
- [Curriculum Vitae]